IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of — Atty. Docket

GERARD DE HAAN ET AL. — NL 010094

SERIAL NO.: — GROUP ART UNIT:

FILED: CONCURRENTLY — EXAMINER:

MOTION ESTIMATOR FOR REDUCED HALOS IN MC UP-CONVERSION

Commissioner for Patents
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

Prior to calculating the filing fee and examination, please amend the above-identified application as follows:

IN THE CLAIMS

Please amend the claims as follows:

1. (Amended) A method for detecting motion at a temporal intermediate position between previous and next images, in which a criterion function for candidate vectors is optimized, said function depending on data from both previous and next images and in which the optimizing is carried out at the temporal intermediate position in non-covering and non-uncovering areas, characterized in that the optimizing is carried out at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas.

2. (Amended) The method as claimed in claim 1, wherein the previous image is shifted over a fraction α times the candidate vector, the next image is shifted over 1 $-\alpha$ times the candidate vector and the fraction α may change within the image period.

3. (Amended) The method as claimed in claim 1, wherein the criterion function is a match error which is minimized.

4. (Amended) The method as claimed in claim 2, wherein the fraction α is controlled by a covering/uncovering detector in the matching process.

5. (Amended) The method as claimed in claim 4, wherein the fraction α is set to 1 in case of covering and set to 0 in case of uncovering.

6. (Amended) The method as claimed in claim 4, wherein the covering/uncovering detector decides on data in a previous image to the fraction α in the current estimation.

7. (Amended) The method as claimed in claim 1, wherein a velocity edge X_E is determined, an occlusion area is marked around said edge, and in said occlusion area, foreground velocity is replaced by background velocity or reversibly dependent on whether the occlusion area is a covering or uncovering area, the sign of the foreground velocity and on which side of the velocity edge X_E the foreground is.

8. (Amended) The method as claimed in claim 7, wherein at the position $\vec{x}_1$ of a velocity edge

- a first position $\vec{x}_a$ in the previous (covering) or next (uncovering) image is calculated by shifting $\vec{x}_1$ over the first vector at one side of the edge

- a second position $\vec{x}_b$ in the previous (covering) or next (uncovering) image is calculated by shifting $\vec{x}_1$ over the second vector at the other side of the edge
- and a third intermediate position between $\vec{x}_a$ and $\vec{x}_b$ is calculated
- while finally, the vector fetched with $v_{\tilde{a}v}$ at the third position in the previous (covering) or next (uncovering) image is filled in those regions of the image in the environment of the edge, to which no vector is projected, in case the background vector $v_{\tilde{B}G}$ should be filled in, and the vector chosen between $\vec{D}(\vec{x}-\begin{pmatrix}1\\0\end{pmatrix},n)$ and $\vec{D}(\vec{x}+\begin{pmatrix}1\\0\end{pmatrix},n)$ which is most different from $v_{\tilde{a}v}$ is filled in, in case a foreground vector $v_{\tilde{F}G}$ should be filled in.

9. (Amended) The method as claimed in claim 8, wherein the intermediate position is $(\vec{x}_a + \vec{x}_b)/2$.

10. (Amended) The method as claimed in claim 7, wherein a background velocity is identified as a velocity which crosses the velocity discontinuity and projects to a foreground velocity in the previous picture, whereas a foreground velocity projects to itself.

11. (Amended) The method as claimed in claim 7, wherein near edges it is tested whether the mentioned edge has moved over the first vector on one side of the edge, or over the second vector on the other side of the edge, in case the edge moves with the first (second) vector, the second (first) vector is filled in those regions of the projected vector field in the environment of the edge, to which no vector is projected, in case a background vector $v_{\hat{B}G}$ should be filled in, and the other vector is filled in, in case a foreground vector $v_{\hat{F}G}$ should be filled.

12. (Amended) The method as claimed in claim 10, wherein the crossing from a background region to a foreground region in the previous image is verified by the match error of the vector in that block.

13. (Amended) An apparatus for detecting motion at a temporal intermediate position between previous and next images, comprising means for optimizing a criterion function for candidate vectors, said function depending on data from both previous and next images in which the optimizing is carried out at the temporal intermediate position in non-covering and non-uncovering areas, characterized in that said apparatus further comprises means for detecting covering or uncovering areas, wherein the optimizing is carried out at the

temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas.

14. (Amended) The apparatus as claimed in claim 13, wherein the previous image is shifted over a fraction α times the candidate vector, the next image is shifted over $1 - \alpha$ times the candidate vector and the fraction α may change within the image period.

15. (Amended) The apparatus as claimed in claim 13, wherein the criterion function is a match error which is minimized.

16. (Amended) The apparatus as claimed in claim 14, wherein said apparatus further comprises a covering/uncovering detector for controlling the fraction α in the matching process.

17. (Amended) The apparatus as claimed in claim 16, wherein the fraction α is set to 1 in case of covering and set to 0 in case of uncovering.

18. (Amended) The apparatus as claimed in claim 16, wherein the covering/uncovering detector decides on data in a previous image to the fraction α in the current estimation.

19. (Amended) The apparatus as claimed in claim 13, wherein a velocity edge X_E is determined, an occlusion area is marked around said edge, and in said occlusion area, foreground velocity is replaced by background velocity or reversibly dependent on whether the occlusion area is a covering or uncovering area, the sign of the foreground velocity and on which side of the velocity edge X_E the foreground is.

20. (Amended) The apparatus as claimed in claim 19, wherein said apparatus further comprises calculation means for, at the position $\vec{x}_1$ of a velocity edge, calculating

- a first position $\vec{x}_a$ in the previous (covering) or next (uncovering) image by shifting $\vec{x}_1$ over the first vector at one side of the edge
- a second position $\vec{x}_b$ in the previous (covering) or next (uncovering) image by shifting $\vec{x}_1$ over the second vector at the other side of the edge
- and a third intermediate position between $\vec{x}_a$ and $\vec{x}_b$,
- while finally, the vector fetched with $v_{\vec{a}v}$ at the third position in the previous (covering) or next (uncovering) image (9) is filled in those regions of the image in the environment of the edge, to which no vector is projected, in case the background vector $v_{\vec{B}G}$

should be filled in, and the vector chosen between $\vec{D}(\vec{x}-\begin{pmatrix}1\\0\end{pmatrix},n)$ and $\vec{D}(\vec{x}+\begin{pmatrix}1\\0\end{pmatrix},n)$ which is most different from $v_{\vec{a}v}$ is filled in, in case a foreground vector $v_{\vec{F}G}$ should be filled in.

21. (Amended) The apparatus as claimed in claim 20, wherein the intermediate position is $(\vec{x}_a + \vec{x}_b)/2$.

22. (Amended) The apparatus as claimed in claim 19, wherein said apparatus further comprises means for projecting two positions on either side of the edge to the previous (covering) or next (uncovering) image, in which a background velocity is identified as a velocity which crosses the velocity discontinuity and projects to a foreground velocity in the previous picture, whereas a foreground velocity projects to itself.

23. (Amended) The apparatus as claimed in claim 19, wherein said apparatus further comprises means for testing near edges whether the mentioned edge has moved over the first vector on one side of the edge, or over the second vector on the other side of the edge, in case the edge moves with the first (second) vector, the second (first) vector is filled in those regions of the projected vector field in the environment of the edge, to which no

vector is projected, in case a background vector $v_{\tilde{B}G}$ should be filled in, and the other vector is filled in, in case a foreground vector $v_{\tilde{F}G}$ should be filled.

24. (Amended) The apparatus as claimed in claim 22, wherein said apparatus further comprises verification means for verifying the crossing from a background region to a foreground region in the previous image by the match error of the vector in that block.

25. (Amended) An image display apparatus comprising apparatus for detecting a motion vector as claimed in claim 13, means for interpolating image parts connected to said detecting apparatus, and a display device connected to the interpolating means.

REMARKS

The claims have been amended to more clearly define the invention as disclosed in the written description. In particular, claim 19 has been made a proper singularly dependent claim depending from claim 13. In addition, the claims have been amended for clarity.

When the Examiner takes this case up for examination, it is respectfully requested that this Preliminary Amendment be taken into consideration.

Respectfully submitted,

by [signature]
Edward W. Goodman, Reg. 28,613
Attorney
Tel.: 914-333-9611

APPENDIX

1. (Amended) ~~Method~~ A method for detecting motion at a temporal intermediate position between previous and next images, in which a criterion function for candidate vectors is ~~optimised~~optimized, said function depending on data from both previous and next images and in which the ~~optimising~~ optimizing is carried out at the temporal intermediate position in non-covering and non-uncovering areas, ~~characterised~~ characterized in that the ~~optimising~~ optimizing is carried out at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas.

2. (Amended) ~~Method according to~~The method as claimed in claim 1, wherein the previous image is shifted over a fraction α times the candidate vector, the next image is shifted over $1 - \alpha$ times the candidate vector and the fraction α may change within the image period.

3. (Amended) ~~Method according to~~ The method as claimed in claim 1, wherein the criterion function is a match error which is ~~minimised~~minimized.

4. (Amended) ~~Method according to~~ The method as claimed in claim 2, wherein the fraction α is controlled by a covering/uncovering detector in the matching process.

5. (Amended) ~~Method according to~~ The method as claimed in claim 4, wherein the fraction α is set to 1 in case of covering and set to 0 in case of uncovering.

6. (Amended) ~~Method according to~~ The method as claimed in claim 4, wherein the covering/uncovering detector decides on data in a previous image to the fraction α in the current estimation.

7. (Amended) ~~Method according to~~ The method as claimed in claim 1, wherein a velocity edge X_E is determined, an occlusion area is marked around said edge, and in said occlusion area, foreground velocity is replaced by background velocity or reversibly dependent on whether the occlusion area is a covering or uncovering area, the sign of the foreground velocity and on which side of the velocity edge X_E the foreground is.

8. (Amended) ~~Method according to~~ The method as claimed in claim 7, wherein at the position $\vec{x}_1$ of a velocity edge

- a first position $\vec{x}_a$ in the previous (covering) or next (uncovering) image is calculated by shifting $\vec{x}_1$ over the first vector at one side of the edge
- a second position $\vec{x}_b$ in the previous (covering) or next (uncovering) image is calculated by shifting $\vec{x}_1$ over the second vector at the other side of the edge
- and a third intermediate position between $\vec{x}_a$ and $\vec{x}_b$ is calculated
- while finally, the vector fetched with $v_{\vec{a}v}$ at the third position in the previous (covering) or next (uncovering) image is filled in those regions of the image in the environment of the edge, to which no vector is projected, in case the background vector $v_{\vec{B}G}$ ~~$v_{\vec{F}G}$~~ should be filled in, and the vector chosen between $\vec{D}(\vec{x}-\begin{pmatrix}1\\0\end{pmatrix},n)$ and $\vec{D}(\vec{x}+\begin{pmatrix}1\\0\end{pmatrix},n)$ which is most different from $v_{\vec{a}v}$ is filled in, in case a foreground vector $v_{\vec{F}G}$ should be filled in.

9. (Amended) ~~Method according to~~ The method as claimed in claim 8, wherein the intermediate position is $(\vec{x}_a + \vec{x}_b)/2$.

10. (Amended) ~~Method according to~~ The method as claimed in claim 7, wherein a background velocity is identified as a velocity

which crosses the velocity discontinuity and projects to a foreground velocity in the previous picture, whereas a foreground velocity projects to itself.

11. (Amended) ~~Method according to~~ The method as claimed in claim 7, wherein near edges it is tested whether the mentioned edge has moved over the first vector on one side of the edge, or over the second vector on the other side of the edge, in case the edge moves with the first (second) vector, the second (first) vector is filled in those regions of the projected vector field in the environment of the edge, to which no vector is projected, in case a background vector $v_{\tilde{B}G}$ should be filled in, and the other vector is filled in, in case a foreground vector $v_{\tilde{F}G}$ should be filled.

12. (Amended) ~~Method according to~~ The method as claimed in claim 10, wherein the crossing from a background region to a foreground region in the previous image is verified by the match error of the vector in that block.

13. (Amended) ~~Apparatus~~ An apparatus for detecting motion at a temporal intermediate position between previous and next images, comprising means ~~(1) optimising~~for optimizing a criterion function for candidate vectors, said function depending on data from both previous and next images in which the ~~optimising~~ optimizing is

carried out at the temporal intermediate position in non-covering and non-uncovering areas, ~~characterised~~ characterized in that said apparatus further comprises means for ~~detection~~ detecting covering or uncovering areas, wherein ~~(2) are provided and that~~ the ~~optimising~~ optimizing is carried out at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas.

14. (Amended) ~~Apparatus according to~~ The apparatus as claimed in claim 13, wherein the previous image is shifted over a fraction α times the candidate vector, the next image is shifted over 1 $-\alpha$ times the candidate vector and the fraction α may change within the image period.

15. (Amended) ~~Apparatus according to~~ The apparatus as claimed in claim 13, wherein the criterion function is a match error which is ~~minimised~~minimized.

16. (Amended) ~~Apparatus according to~~ The apparatus as claimed in claim 14, wherein said apparatus further comprises a covering/uncovering detector for controlling the fraction α ~~is controlled by a covering/uncovering detector (2)~~ in the matching process.

17. (Amended) ~~Apparatus according to~~ The apparatus as claimed in claim 16, wherein the fraction α is set to 1 in case of covering and set to 0 in case of uncovering.

18. (Amended) ~~Apparatus according to~~ The apparatus as claimed in claim 16, wherein the covering/uncovering detector ~~(2)~~ decides on data in a previous image to the fraction α in the current estimation.

19. (Amended) ~~Apparatus according to one of the preceding claims~~The apparatus as claimed in claim 13, wherein a velocity edge X_E is determined, an occlusion area is marked around said edge, and in said occlusion area, foreground velocity is replaced by background velocity or reversibly dependent on whether the occlusion area is a covering or uncovering area, the sign of the foreground velocity and on which side of the velocity edge X_E the foreground is.

20. (Amended) ~~Apparatus according to~~ The apparatus as claimed in claim 19, wherein said apparatus further comprises calculation means ~~(5,6,8) are provided~~ for, at the position $\vec{x}_1$ of a velocity edge, calculating

- a first position $\vec{x}_a$ in the previous (covering) or next (uncovering) image by shifting $\vec{x}_1$ over the first vector at one side of the edge
- a second position $\vec{x}_b$ in the previous (covering) or next (uncovering) image by shifting $\vec{x}_1$ over the second vector at the other side of the edge
- and a third intermediate position between $\vec{x}_a$ and $\vec{x}_b$,
- while finally, the vector fetched with $v_{\vec{av}}$ at the third position in the previous (covering) or next (uncovering) image (9) is filled in those regions of the image in the environment of the edge, to which no vector is projected, in case the background vector $v_{\vec{BG}}$ ~~$v_{\vec{FG}}$~~ should be filled in, and the vector chosen between $\vec{D}(\vec{x}-\begin{pmatrix}1\\0\end{pmatrix},n)$ and $\vec{D}(\vec{x}+\begin{pmatrix}1\\0\end{pmatrix},n)$ which is most different from $v_{\vec{av}}$ is filled in, in case a foreground vector $v_{\vec{FG}}$ should be filled in.

21. (Amended) ~~Apparatus according to~~ The apparatus as claimed in claim 20, wherein the intermediate position is $(\vec{x}_a + \vec{x}_b)/2$.

22. (Amended) ~~Apparatus according to~~ The apparatus as claimed in claim 19, wherein said apparatus further comprises means

~~(10,11) are provided~~ for projecting two positions on either side of the edge to the previous (covering) or next (uncovering) image, in which a background velocity is identified ~~(14)~~ as a velocity which crosses the velocity discontinuity and projects to a foreground velocity in the previous picture, whereas a foreground velocity projects to itself.

23. (Amended) ~~Apparatus according to~~ The apparatus as claimed in claim 19, wherein said apparatus further comprises means ~~(20) are provided~~ for testing near edges whether the mentioned edge has moved over the first vector on one side of the edge, or over the second vector on the other side of the edge, in case the edge moves with the first (second) vector, the second (first) vector is filled in those regions of the projected vector field in the environment of the edge, to which no vector is projected, in case a background vector $v_{\tilde{B}G}$ should be filled in, and the other vector is filled in, in case a foreground vector $v_{\tilde{F}G}$ should be filled.

24. (Amended) ~~Apparatus according to~~ The apparatus as claimed in claim 22, wherein said apparatus further comprises verification means ~~are provided~~ for verifying the crossing from a background region to a foreground region in the previous image by the match error of the vector in that block.

25. (Amended) ~~Image~~ An image display apparatus comprising ~~detection~~ apparatus ~~(21)~~ for ~~detection~~ detecting a motion vector ~~according to~~ as claimed in claim 13, means ~~(22)~~ for interpolating image parts connected to said ~~detection~~ detecting apparatus, ~~(21)~~ and a display device ~~(23)~~ connected to the interpolating means.